IN THE SPECIFICATION:

On page 1 of the English language translation of the specification, please add a heading before the first full paragraph of the specification to appear as follows:

<u>Technical Field</u>

On page 1 of the English language translation of the specification, please add a heading before the second full paragraph of the specification to appear as follows:

<u>Background</u>

On page 2 of the English Language translation of the specification, please amend the second full paragraph of the specification to appear as follows:

In particular in connection with components of the drive train made from hardenable steel in the automotive industry, therefore, there is a constant problem with providing a welding process which, in mass terms, provides an energy per unit length of weld which is sufficient to achieve a high-quality, usable and robust weld seam. This means in particular that <u>if</u> torsionally rigid joining of shafts or similar components is to be realized; this joining process should be suitable for integration in flow line manufacture. Furthermore, the welding process should be as inexpensive and uncomplicated as possible with regard to handling. Moreover, it would be advantageous if it were possible to specify a welding process which is flexible with regard to possible component geometries and/or different configurations of the weld seams. The joins produced by the process should in particular satisfy the demands imposed in the automotive industry.

On page 3 of the English language translation of the specification, please add a heading before the first full paragraph to appear as follows:

<u>Summary Of The Invention</u>

On page 3 of the English Language translation of the specification, please amend the first full paragraph of the specification to appear as follows:

~~It is an object of the~~ The present invention [[to]] at least partially ~~alleviate~~ alleviates the problems which have been described in connection with the prior art and/or [[to]] at least partially ~~realize~~ realizes the objectives mentioned above. In particular, ~~it is intended to describe~~ the following describes a gas welding process which ensures crack-free joining of components made from hardenable steel. The gas welding process should preferably provide joins between components of a drive train of a motor vehicle which satisfy the demands imposed in the automotive industry.

On page 3 of the English Language translation of the specification, please amend the second full paragraph of the specification to appear as follows:

~~These objects are achieved by a process for producing a weld seam having the features of Patent Claim 1 and Patent Claim 2. Preferred configurations of the process and joins between at least two components for torque transmission produced by the process, as well as associated vehicles, are described in the dependent patent claims.~~ It should be noted that the features listed ~~in the patent claims~~ herein can be combined with one another in any technologically appropriate way. Moreover, the combinations described ~~in the patent claims~~ can be characterized in more detail by features of the description.

On page 3 of the English Language translation of the specification, please amend the third full paragraph of the specification to appear as follows:

~~The~~ A process according to one embodiment of the invention for producing a weld seam in hardenable steel having a material thickness without secondary heating comprises at least the following steps:

a) positioning a welding electrode with respect to a weld line;
b) applying a voltage;
c) supplying a plasma gas;
d) forming an arc; and
e) melting the steel in the vicinity of the weld line over the entire material thickness.

On page 4 and continuing on page 5 of the English Language translation of the specification, please amend the first full paragraph of the specification to appear as follows:

In accordance with step a), the welding electrode is positioned or aligned with respect to the weld line. It is in this context irrelevant whether the welding electrode is aligned with respect to the component or vice versa. The welding electrode ~~is preferably~~ can be a tungsten electrode. This welding electrode is connected to a starting device or a welding energy source. Then, in accordance with step b), a voltage is applied. It is in principle possible for the voltage to be formed between parts of the welding torch itself, so as to produce what is known as a "non-transmitting" arc. It is however preferred in the present case to form a "transmitting" arc, in which case a voltage is provided between the welding electrode and the component made from hardenable steel. Transformers, rectifier assemblies, pulse generators, etc. can be used to provide the desired welding voltage. Next, in accordance with step c), plasma gas is supplied. ~~It is preferable for the~~ The plasma gas likewise [[to]] can be supplied using the welding torch, in which case the plasma gas advantageously flows out centrally and in the immediate vicinity of the welding electrode. Then, an arc is formed (step d)). On account of the interaction between plasma gas and arc, a concentrated, high-energy introduction of heat into the components made from hardenable steel is ensured. In accordance with step e), as a consequence of this introduction of heat, the hardenable steel is then melted over the entire material thickness in the vicinity of the weld line. This makes use in particular of what is known as the "keyhole effect". In this case, the plasma jet melts the material over its entire depth, so as to form a keyhole. During welding, the plasma jet moves with the keyhole along the abutting edges. Behind the plasma jet, the molten metal flows back together on account of the surface tension of the molten pool and the ~~vapour~~ vapor pressure in the keyhole, thereby forming the weld seam.

On page 5 of the English Language translation of the specification, please amend the first full paragraph of the specification to appear as follows:

During the plasma keyhole welding proposed here, energy is introduced into the hardenable steel to such an extent that self-quenching or undesirable surface hardening of the material does not occur. Therefore, for the first time, a welding process is ~~proposed~~ provided which uses electrical gas discharge (plasma welding) on the one hand to realize a concentrated, high-energy introduction of heat without secondary heating; and on the other hand at the same time to avoid major component distortion as a result of large-area introduction of heat. Despite the concentrated, high-energy introduction of heat, the heat distribution and heat management can be set in such a way that the cooling gradients do not enter the critical range, as occurs for example

when using laser or electron beam welding. Consequently, there is no need for secondary heating before, during or after the welding operation, and crack-free weld seams can be obtained.

On page 5 and continuing on page 6 of the English Language translation of the specification, please amend the second full paragraph of the specification to appear as follows:

With regard to the "crack-free" configuration of the weld seam, it should be ~~explained~~ understood that this form of join does not include any macro-cracks, as they are known, i.e. cracks of a size which is such that they are visible to the naked eye. Smaller micro-cracks, as they are known (the length of these cracks is often only in the region of a grain diameter of the material, and they can only be perceived by microscopic (metallographic) methods) in this case also only occur to an acceptable extent. In the present context, a "crack" is in particular a limited material separation with a predominantly two-dimensional extent, which may occur in the weld metal, in the heat-affected zone and/or in the base metal, in particular on account of internal stresses. A "crack" needs to be distinguished, for example, from cavities, gas inclusions, pores, voids, solid inclusions and/or other defects in a weld seam. Although the defects in a weld seam which are distinct from cracks should of course also be avoided as far as possible, in the present context, the primary objective is freedom from (macro-) cracks, since cracks are the most ~~dangerous~~ serious and widespread form of defect, making subsequent repair imperative. This has also been the reason over the course of many years why steels with a high carbon content, which for example are subject to considerable stresses in use, have only been welded with secondary heating.

On page 6 of the English Language translation of the specification, please amend the first full paragraph of the specification to appear as follows:

A further aspect of the present invention ~~proposes~~ provides a process for joining components for torque transmission in a vehicle made from hardenable steel and having a material thickness by producing a weld seam without secondary heating, which comprises at least the following steps:

a) positioning a welding electrode with respect to a weld line;
b) applying a voltage;
c) supplying a plasma gas;
d) forming an arc; and
e) melting the steel in the vicinity of the weld line over the entire material thickness.

On page 6 and continuing on page 7 of the English Language translation of the specification, please amend the second full paragraph of the specification to appear as follows:

The process ~~proposed here~~ is a special application for the welding process described above. In this context, the welding process is used for joining components for torque transmission in a vehicle. On account of the high stressing of the components in use, particular specifications with regard to the quality of the weld seam, the dimensional accuracy, etc. need to be complied with. In this context, a weld seam is implemented in particular as a square butt weld, in which the components to be joined are placed so as to abut one another. The weld seam itself may be designed as a radial and/or axial seam. It is in this way ~~preferable~~ possible to weld a radial circumferential seam without root protection. The weld seam is free of cracks and extreme undercuts and corresponds to common conceptions with regard to weld and root reinforcement, which is to be understood as meaning the subregions of the weld seam which in each case project above the original surface of the parts to be joined. The roots of the weld seam are in this case formed on that side of the weld seam which lies on the side of the components remote from the welding electrode. In this context, it is also preferable for angle errors (for example caused by partial, time-offset shrinkage during solidification) to be kept in the range of less than 0.5% even in series production. At the same time, it is easily possible to prevent the components from being offset with respect to one another during the joining process, so that an offset of less than 0.2 mm can be ensured. This welding process enables the item costs of the welded components of the drive train of vehicles to be kept at a low level, since there is no need for long weld preparation work and/or component remachining work.

On page 7 and continuing on page 8 of the English Language translation of the specification, please amend the first full paragraph of the specification to appear as follows:

According to a refinement of the process, the hardenable steel has a material thickness in the range from 2.0 mm to 10.0 mm. The range ~~is preferably~~ can be from 2.0 mm to 8.0 mm, and in particular the range is from 4.0 mm to 6.0 mm. In the case of hardenable steels with this material thickness, it is possible to realize the "keyhole effect" in a reliable way, so that the desired introduction of energy and/or the desired formation of the weld seam is ensured. In particular with the material thicknesses indicated here, ~~it is proposed that~~ the energy per unit length introduced by the welding process can be in

the range from 234 J/mm to 3360 J/mm [Joules per ~~millimetre~~ millimeter]. Therefore, the energy per unit length introduced is, for example, considerably higher than in the case of beam welding, such as for example in a CO_2 laser. In the case of plasma keyhole welding, the energy per unit length ~~is preferably~~ can be in a range which is at least a factor of four higher than in the case of a CO_2 laser at the same welding speeds.

On page 8 of the English Language translation of the specification, please amend the first full paragraph of the specification to appear as follows:

Furthermore, ~~it is proposed that~~ the weld seam can be of single-layer design. It is in this case preferable for the components made from hardenable steel that are to be joined also not to be locally fixed, in particular tacked, beforehand. Carrying out single-layer welding leads to a very uniform formation of the weld seam, so that asymmetrical seam geometries which occur for example in the case of multi-layer welds, and resulting angle distortions, can be avoided. The single-layer through-welding, on account of its seam depth, seam width and seam shape, generates transient tensile stresses to an extent which is such that, in combination with the sufficient ductility of the material, these stresses do not lead to cracks. Producing a single-layer through-welding, which on account of its seam depth, seam width and seam shape and the resultant locally limited introduction of heat generates transient tensile stresses to this extent, has the advantage that only very minor component distortion occurs.

On page 9 of the English Language translation of the specification, please amend the first full paragraph of the specification to appear as follows:

The process in which a plasma jet, during the welding operation, is moved in the welding direction at a speed of at least 0.2 m/min [meters per minute] is particularly preferred. It is even preferable for the welding speed to be above 0.5 m/min. It is ~~very~~ also particularly ~~preferable~~ advantageous for the welding speed not to exceed a value of 5.0 m/min.

On page 9 of the English Language translation of the specification, please amend the second full paragraph of the specification to appear as follows:

In particular at the welding speeds proposed here, a welding current of at least 170 A ~~[amperes]~~ is applied. ~~It is preferable for the~~ The welding current should not [[to]] exceed a limit of 400 A. A process in which the plasma jet, during the welding operation, in the welding direction effects an energy per unit length of weld whose upper limit is set in such a way that the strength of the weld seam is above that of the adjoining components, is particularly ~~preferred~~ advantageous. The lower limit ~~is preferably~~ can be set in such a way that it is possible to ensure a sufficient ductility of the weld seam, which is limited by weld seam hardnesses of at most 650 HV.

On page 9 of the English Language translation of the specification, please amend the third full paragraph of the specification to appear as follows:

The configuration of the process in which the weld seam is produced by radial circumferential welding is ~~particularly preferred~~ also possible. This applies in particular with regard to the joining of components for torque transmission in a vehicle made from hardenable steel. This is to be understood in particular as a variant of the welding process in which a circumferentially continuous weld seam is produced for hollow profiled sections. The arc is in this case moved radially around the component or components. A process of this type is recommended, for example, for the end-side joining of hollow shafts or similar components.

On page 10 of the English Language translation of the specification, please amend the second full paragraph of the specification to appear as follows:

A join produced by a process described in accordance with the invention, in particular plasma keyhole welding, can for example be clearly recognized, by virtue of the fact that the weld seam is in single-layer form and accordingly is generally designed with an aspect ratio (V_A) of depth to width of the weld seam of approx. 1.0:1.5 to approx. 1.0:2.0 (in particular in the range V_A = 1.0:1.2 to 1.0:1.8). The width of the heat-affected zone based on the ~~contre~~ center of the weld seam is greater than that of a beam weld (using laser V_A is approximately 2.5:1.0) but significantly smaller than that of a manual electrode or gas weld (when using MIG welding processes, V_A is approximately 1.0:3.0).

On page 10 of the English Language translation of the specification, please amend the third full paragraph of the specification to appear as follows:

A join of this type has proven advantageous in particular if at least one of the components is a hollow shaft with a wall thickness in the range from 2.0 mm to 10.0 mm. ~~It is very particularly preferable for~~ For example, the hollow shaft [[to]] can have a wall thickness in the range from 2.0 mm to 8.0 mm, and in particular in the range from 4.0 mm to 6.0 mm. These hollow shafts ~~are preferably~~ can be propshafts or sideshafts of a car, for example.

On page 11 of the English Language translation of the specification, please amend the first full paragraph of the specification to appear as follows:

~~It is also proposed that the~~ The join and adjoining subregions of the components ~~be of~~ can have a crack-free design. With regard to the applicable meaning of "crack-free" in this context, reference is made to the statements given above in this context. This in particular allows high dynamic, long-term cyclic stresses and static torsional stresses on the join. For example, joins of this type withstand a dynamic long-term cyclic stressing of 300,000 oscillation cycles at a torque of ± 1100 Nm and 1650 Nm [Newton meters]. With regard to the static torsional stressing, the fracture torque is at least 3200 Nm.

On page 11 of the English Language translation of the specification, please amend the second full paragraph of the specification to appear as follows:

According to an advantageous configuration of the join, the latter has a ductility in the range from 250 HV to 650 HV. This is to be understood as meaning that the join or the weld seam leads to the abovementioned result in a Vickers hardness test method. In this context, it is advantageous for the ductility in the region of the weld seam and the heat-affected zone to be above the component in the normal state. In this context, ~~it is preferable for~~ the ductility [[to]] can be in a range up to approximately 500 HV.

On page 11 and continuing on page 12 of the English Language translation of the specification, please amend the fourth full paragraph of the specification to appear as follows:

As has already been mentioned a number of times, ~~the preferred~~ an advantageous use of the process and the join is in the automotive industry. For this reason, the invention also ~~proposes~~ provides a vehicle comprising an engine with a drive system, the drive system having components for torque transmission, and at least two components having been welded together by a process according to the invention, or the vehicle including a corresponding join.

On page 12 of the English language translation of the specification, please add a heading after the second table and before the second full paragraph to appear as follows:

Brief Description Of The Drawings

On page 13 of the English Language translation of the specification, please amend the first full paragraph of the specification to appear as follows:

Fig. 1 diagrammatically depicts the structure of a welding torch during ~~the~~ a welding operation according to an embodiment of the present invention;

On page 13 of the English Language translation of the specification, please amend the fifth full paragraph of the specification to appear as follows:

Fig. 5 diagrammatically depicts a drive system of a vehicle in which the present method may be used to advantage.

On page 13 of the English language translation of the specification, please add a heading after the sixth full paragraph to appear as follows:

Detailed Description

On page 13 and continuing on page 14 of the English Language translation of the specification, please amend the seventh full paragraph of the specification to appear as follows:

Figure 1 shows a diagrammatic and cross-sectional view of a welding torch 33 for carrying out the process according to an embodiment of the invention. The welding torch 33 is formed with a welding electrode 4 which is arranged centrally with respect to the welding torch. The welding electrode 4 made from tungsten is surrounded by a plasma nozzle 22 which includes water cooling 34. During the welding operation, plasma gas 6 is supplied via the plasma nozzle 22. A shielding gas nozzle 21 (~~preferably~~ which can be made from copper) is provided concentrically with respect to the plasma nozzle 22. During the welding process, shielding gas 8 flows out through an annular gap formed around the plasma nozzle 22, and this shielding gas 8, on account of its thermal conductivity, leads to constriction of the arc 7 or the plasma jet 9. As a result, the plasma jet 9 can be guaranteed to have a relatively small diameter 10 even over a great length 11.

On page 15 and continuing on page 16 of the English Language translation of the specification, please amend the seventh full paragraph of the specification to appear as follows:

Figure 5 reveals a drive system 19 for a four-wheel-drive vehicle 10. In this case, all four wheels 26 are driven by an engine 18. An engine transmission 28 can be seen in the region of the front axle and beneath the engine 18 which is also indicated. What is known as an axle transmission 29 is provided in the region of the rear axle. Sideshafts 27 are used to drive the wheels 26. The connection between the engine transmission 28 and the axle transmission 29 is provided by a propshaft arrangement which comprises two hollow shafts 14. This arrangement is additionally mounted on the underbody of the vehicle 17 by an approximately centrally arranged intermediate bearing 31. In a first propshaft portion, the propshaft arrangement has a first joint 30, arranged in the vicinity of the engine transmission 28, in the form of a constant-velocity fixed joint. To connect the two propshaft portions or hollow shafts 14, a second joint 30 is provided in the

~~centre~~ center in the form of a constant-velocity fixed joint. At the end of the second propshaft portion of the hollow shaft 14 shown on the right, there is a third joint 30 in the form of a constant-velocity fixed joint which is connected to the axle transmission 29 via connecting means. The hollow shafts 19 or propshaft portions in most applications rotate at a rotational speed which is above the rotational speed introduced into the manual or automatic transmission by the engine 18. The transmission ratio is stepped down in the region of the axle transmission 29. Whereas, for example, the hollow shafts 14 and the associated joints 30 have to execute rotational speeds of up to 10,000 revolutions per minute, the rotational speeds of the sideshafts 27 for operation of the wheels 26 are of the order of magnitude of up to 2,500 revolutions per minute.

On page 16 and continuing on page 17 of the English Language translation of the specification, please amend the first full paragraph of the specification to appear as follows:

The join according to the invention ~~is preferably~~ can be advantageously used for the following components:

- Propshaft system components which are joined, such as for example:
  - Tubular shaft/solid shaft
  - Tubular shaft/joint outer part
  - Tubular shaft/journal
  - Tubular shaft/joint inner part (e.g.: hub)
  - Joint outer part/housing cover
  - Joint outer part/flange/e.g. transmission flanges
  - Joint disc/joint base
  - Sliding sleeve/shaft journal
- Differential/transmission systems
  - Gear/gear
  - Tubular shaft/gear
  - Housing/housing cover
  - Journal/housing cover

On page 21 of the English Language translation of the specification, please amend the Abstract of the specification to appear as follows:

~~The invention describes a~~ A process for producing a weld seam (1) in hardenable steel (2) having a material thickness (3) without secondary heating, ~~comprising~~ includes at least the following steps: [[a)]] positioning a welding electrode (4) with respect to a weld line (5); [[b)]] applying a voltage; [[c)]] supplying a plasma gas (6); [[d)]] forming an arc (7); and [[e)]] melting the steel (2) in the vicinity of the weld line (5) over the entire material thickness (3). ~~This~~ The process ~~is preferably~~ can be used to join components for torque transmission in motor vehicles.

~~Fig. 1~~